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Geology and Hydrocarbon Potencial arctic regions of the West Siberian basin and the Kara sea.

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The northern part of the West Siberian province is mainly a gas producing area. Onshore, gas forms 80% of hydrocarbon production and potential recoverable reserves are estimated at trillions of cubic meters. The hydrocarbon potential of offshore extensions of West Siberian producing basins may be equally high. Kara Sea basin is a likely target for future exploration interest and development activity.

Arctic part of West Siberian oil-gas basin, including offshore in the Kara-Sea and West of the Enisei-Hatang depression, is characterized by some peculiarities of geological structure and history and as consequence specificity of oil-gas bearing, that distinguishes this area from the rest West Siberia basin. This region has natural geographical boundaries: on the South it is the main watershead of the plain -Siberian Uvali, on the North it is the continental threshold in the Kara-Sea, on the West and East - these are exposed Hercynian and Cimmerian folded systems.

Specificity of the region may not be detected quite definitely in Geological Map (Fig 1), as the Cenozoic and Cretaceous sediments overlap the tectonicaly heterogeneous northern and southern parts of West Siberian plain by the single common cover. More clear picture gives the Scheme of "Major structures and age of the cover"(Fig 2). We can see here the gaint depression gathered round by the slopes of Hercynian-Cimmerian folded systems covered by

Jurassic-Cenozoic series. The internal part of depression is characterised by thick Phanerozoic sequence where thickness variaties from 10 till 15-20km in some parts. In the rather narrow band on the north of Yamal and Gidan peninsulas the middle Triassic-Upper Paleozoic part of the cover is not presented - this structure may be named anteclise. On the rest part of depression, that divided into the two sineclyses- South Kara and Pur-Gidan, the cover includes three structure-formation complexes: Low-Middle Paleozoic, Upper Paleozoic-Triassic and Mesozoic-Cenozoic.

In water area a significant volume of seismic profiling has been performed till now. But by comparing on-shore and off-shore seismic cross-sections we have been able to admit the higher quality and - what is more important - the greater effective depth of an on-shore seismic sections. The same can be applied to drilling. The prospect drilling is being carried out intensively everywhere on-shore including the coast zone and even islands. At the same time only four wells were drilled on two uplifts in a water area although the result is quite impressive - two unique gas fields were discovered.

On Fig.3 a seismic cross-section typical for inside zones of depression is presented. Mesozoic terrigenous complex is underlayed by terrigenous-igneous Upper Paleozoic one, which is continued into the depth by terrigenous-carbonateous Low-Middle Paleozoic. Each complex has some specific features both composition and structural style. Typical basin edge section is presented on Fig.4. The similar architecture is supposed to be in Cimmerian orogen slopes. In the Anteclise, that presents the bridge between Ural and Taimir folded systems, carbonate deposits of Devonian age are covered by Jurassic sediments (Fig.5). Triassic-Upper Paleozoic deposits increase the section both to the northwest and southeast (Fig.6).

The geodepression are of rift origin. The typical rift structure of the internal part of the depression are shown on seismic cross-section (Fig.7). Evidently graben complex is mostly of Low-Middle Paleozoic age. In these rift systems inversion occured in Late Hercynian - Early Cimmerian phase and caused the formation of buried interplatform orogenes.

Within depression area three conjugated paleorift systems can be recognised: North-Eastern (Enisei-Hatang), Meridional (Central West-Siberian) and North-Western. The general form of depression evidently displayes the typical triangle conjunction of rift systems. Riftogenic depression has started to form in Riphean-Early Paleozoic and predominant process of subsidence preserved throughout the entire Fanerozoic stage. The main phase of inversion in the central parts of paleorift troughs took place in Early Mesozoic time.

As a whole the depression are regarded to belong to rift marginal subsidence of an ancient platform. Like Precaspien or Norht Sea marginal depressions this one is ultra-deep. In Russian tectonic literature there are special terms for the structures of such a type: Marginal syneclise (by Shatski), Metaplatform (by Milanovski).

The subsidence process of Post-Triassic time was less differentiated. Only one common Jurassic-Cenozoic depression with the similar sedimentary sequence can be distinguished here. It's thickness variates from nearly 7km in negative structures up to 4-5km on uplifts.

Due to it's tectonic situation the North Depression differs from southern part of West-Siberian hydrocarbon province which is of Paleozoic basement. This fact finally explains different hydrocarbon potential of the northern mainly gas-bearing sub-province and southern oil-bearing one.

In the North Depression the hydrocarbon pools have been revealed for wide stratigraphic diapason of deposites from Cenomanian sandstones till Devonian carbonates.

Nevertheless gas pools sharply dominate in composition of indicated reserves. The portion of liquid hydrocarbons, most part of which is confined to neocomian-jurassic deposites, does not exceed usually 10% from total volume of identified and possible reserves.

The main objects for nearst future exploration and exploitation is the 3-4km of Cretaceous and upper part of Jurassic deposites. Fig.8 displayes some borehole sections from typical tectonic zones: sharp uplift (Harasavey field), depocenter of the basin (Belai Island) and marginal slope (Sverdrup Island). Fig.9 shows the characteristic sequences for Gidan peninsula and extremely east Nearenisei part of the region.

We can see the rithmic structure of the secton. Sandy-argillaceous Jurassic-Cretaceous interval can be divided into several sediment cycles. Due to the transgressive events thick argillaceous caps can be recognised here, massive sand series of highly potential reservoirs correspond to regrassive events. Owing to this on Harasavey field, for example, more than 20 producing horizones (mostly of Aption-Albian) are discovered. Some of them give efficient reflections in CDP sections (Fig.10). The analogous situation take place on Gidan peninsula. For example, it has been determined about 30 pay beds on the Utrennee field confined only to Cretaceous deposites (Fig9). In general whithin the south-eastern part of the depression the main gas-bearing formation is Cenomanian and in the north-western part including Bovanenkovskoye on-shore, Leningradskoye and Rusanovskoye off-shore fields is Aptian-Albian.

The most part of the fields are confined to the large uplifts developed heritagely under the lifted blocks of folded basement. Along with it some fields are controlled by geneticaly specific inverse structures (Fig11). This tectonotype has been established by us before on the example of Enisei-Hatang paleorift system and predicted more wide spreading of them. Offshore seismic sections illustrates Rusanovskoye uplift is also belongs to this type structure(Fig12).

The preliminary gas reserves assesment of two borehole-investigated off-shore structures put them in one row with famous giant gas fields of Yamal Peninsula - Bovanenkovskoye, Harasaveiskoye, Tambeiskoye and Krusenshternovskoye. Our general gas resources estimation of water area structures (Fig13) including partly off-shore fields hesitate between 15 and 20 trillion cube metres. Although the complete assesment of Kara-Sea hydrocarbon potential including Pre-Cretaceous sediments is considered to be the item for investigation in future, it is evidently now that Kara-Sea basin's gas pools are the important objects for the development at the 21-st century. The wide entrance of exploitation enterprises into the Kara-Sea will be undoubtedly preceded by the development of more accessible on-shore gas unique fields. On the first stage of this work it is advisably to put the liquid hydrocarbon pools in exploitation, which total recoverable resources exceed now billion tons.

Geological map

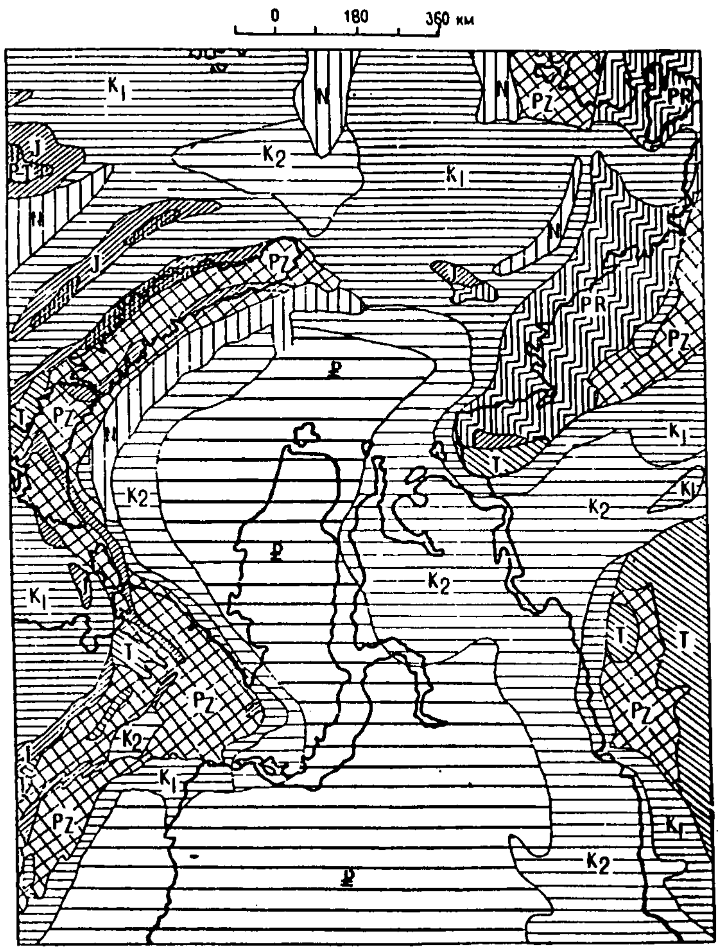


Fig.1

Major structures and age of the cover

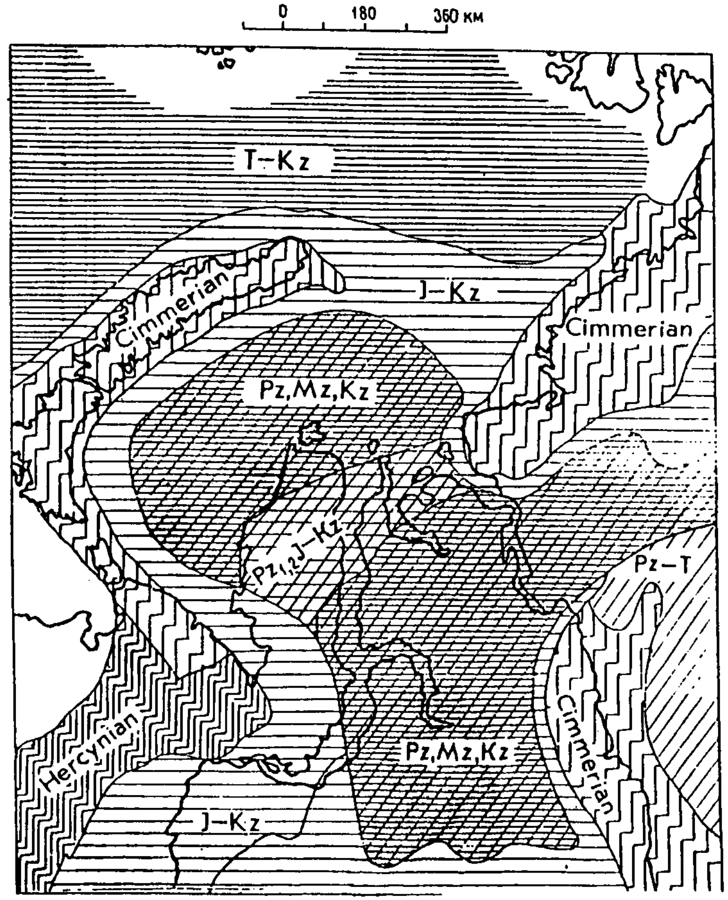
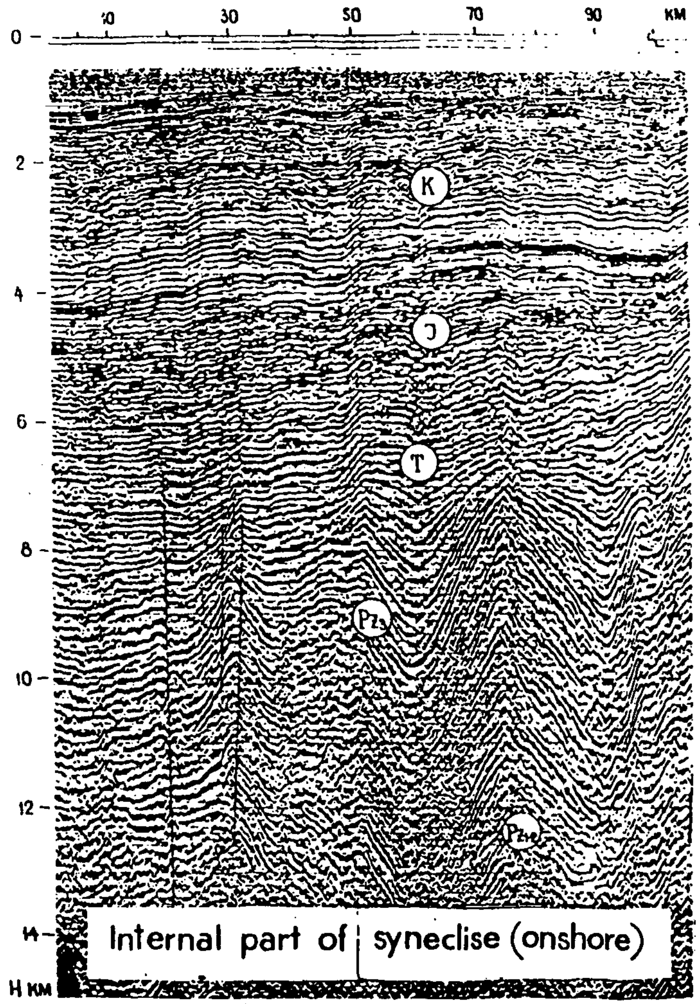
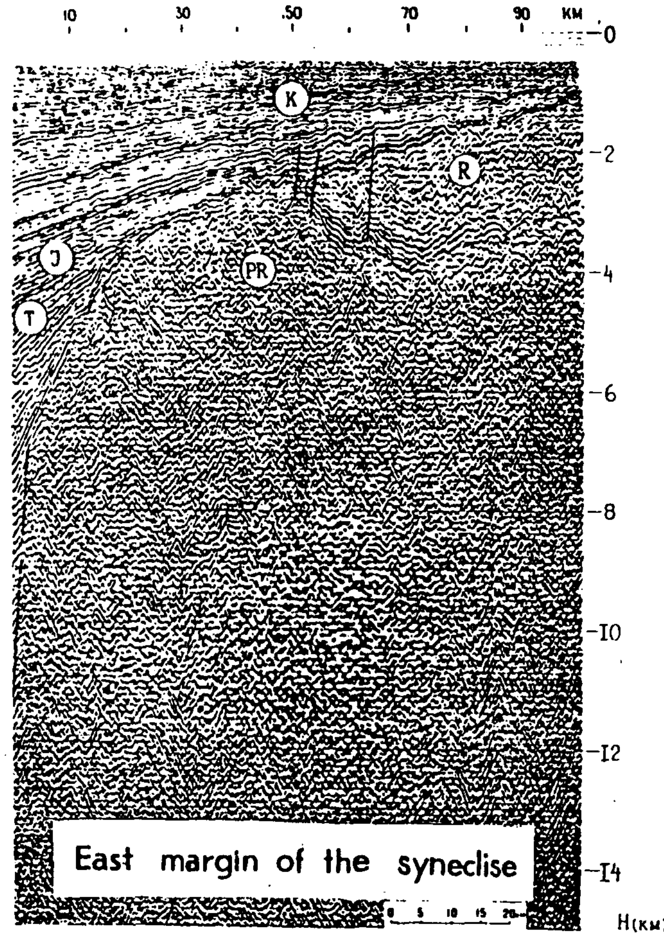


Fig.2



KM
K
J
T
Pz3
Pz1-2
Internal part of syneclise (onshore)
H KM

Fig.3



KM
K
R
J
PR
T
East margin of the syneclise
H(KM)

Fig.4

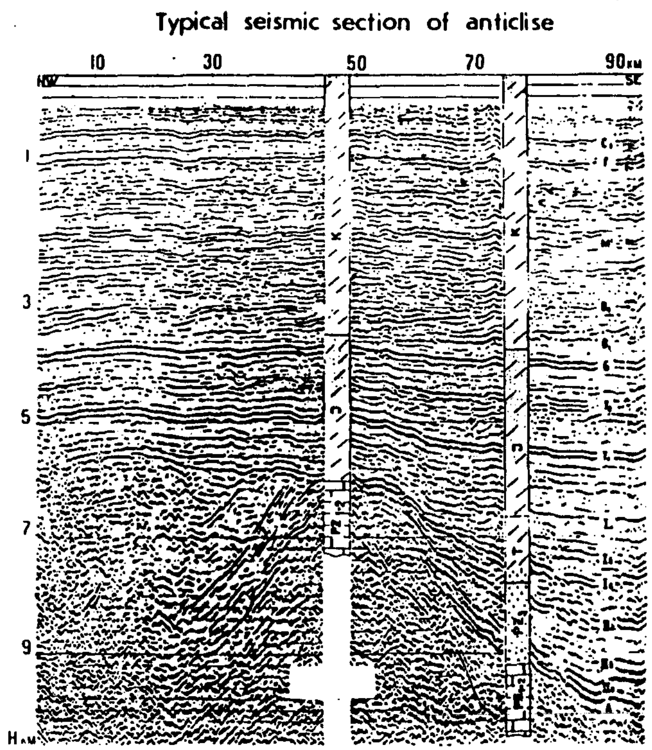

Typical seismic section of anticlise
NW
SE

Fig.5

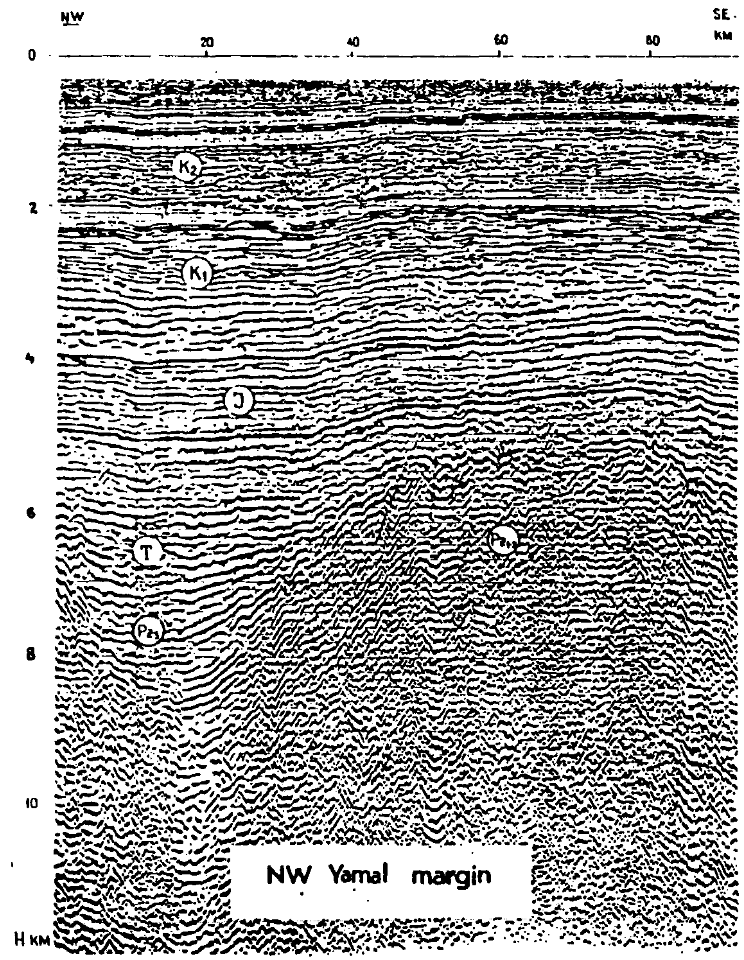

NW
SE
KM
NW Yamal margin

Fig.6

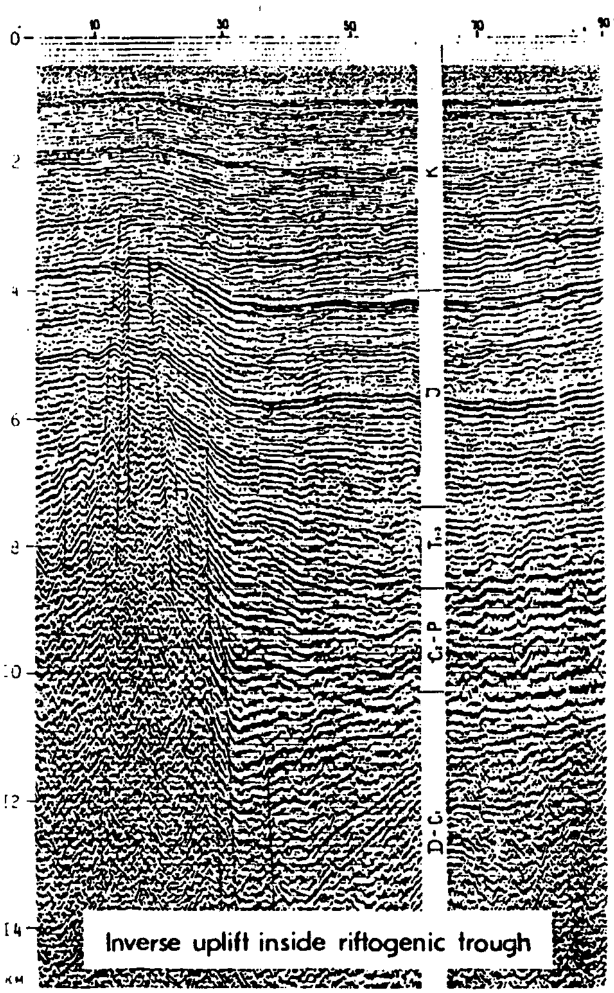


Fig.7

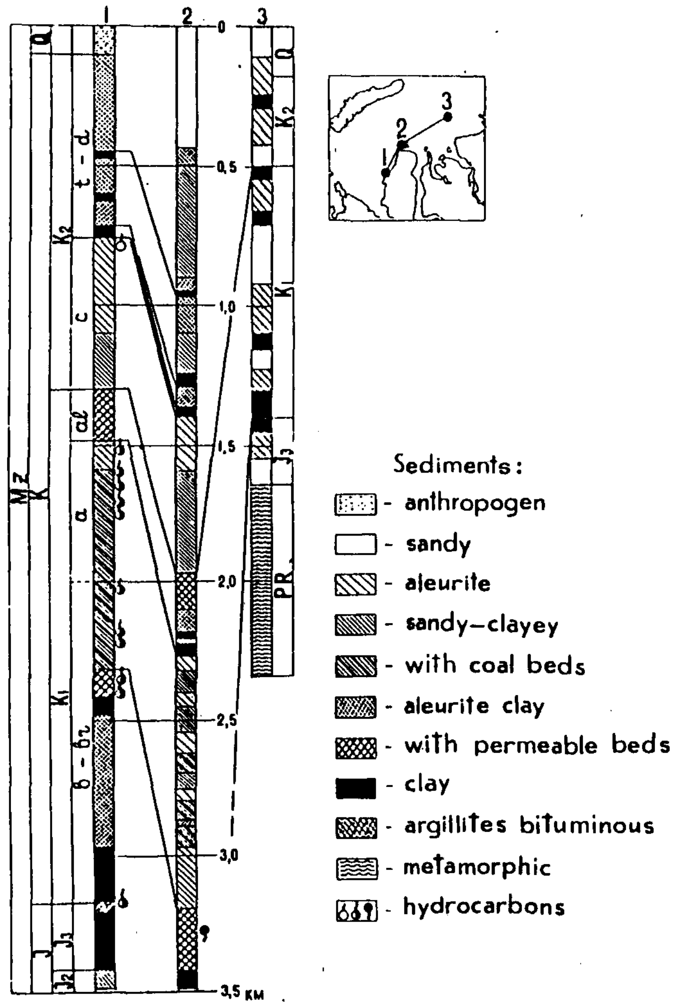


Fig.8

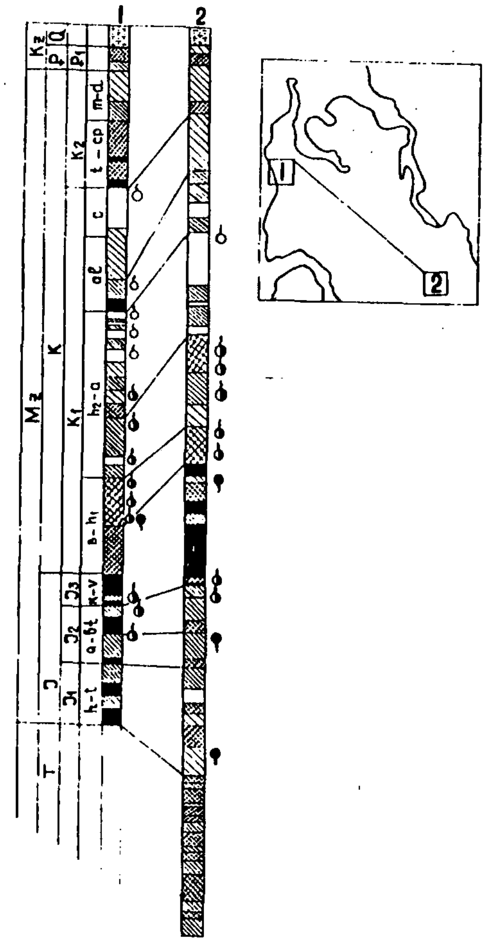
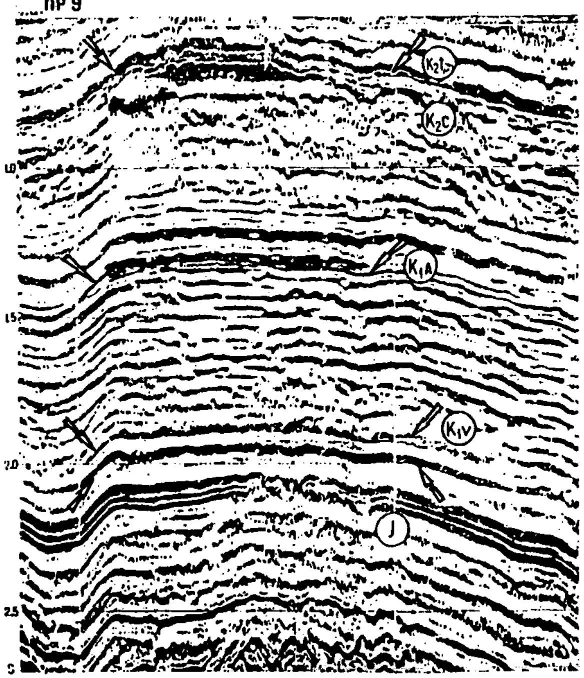


Fig.9

Typical seismic section of North-West Jamal field



Hydrocarbon indicators

Fig.10

Gas-oil bearing and prospective areas

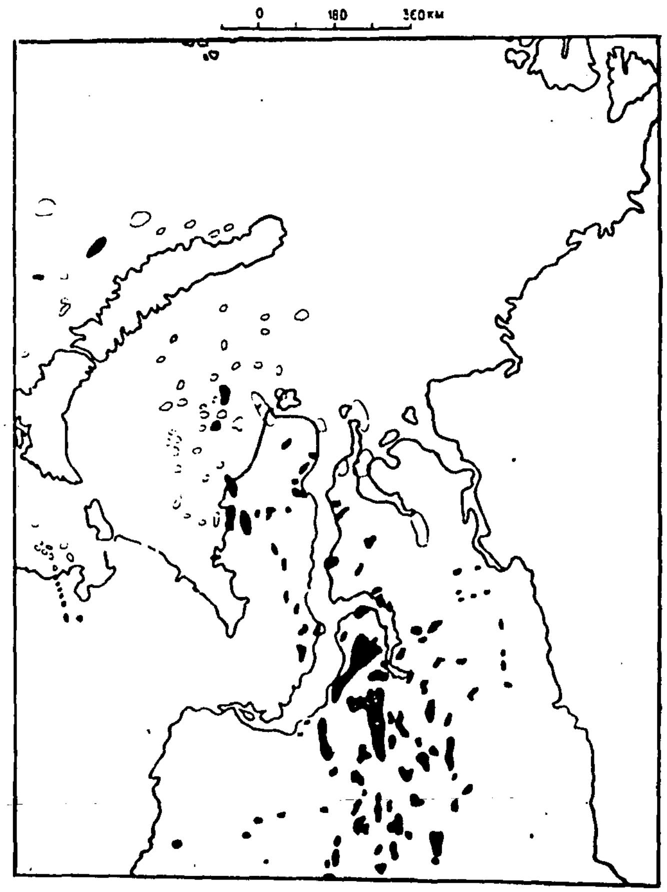


Fig.11

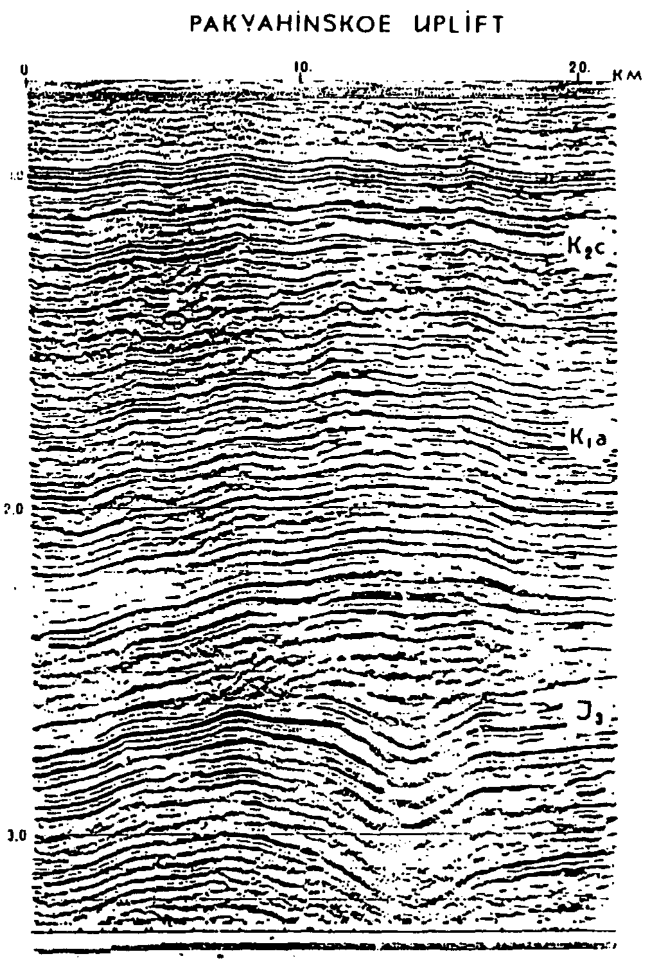

PAKYAHINSKOE UPLIFT
0
10.
20.
KM
2.0
3.0
K_2c
K_1a
J_3

Fig.12

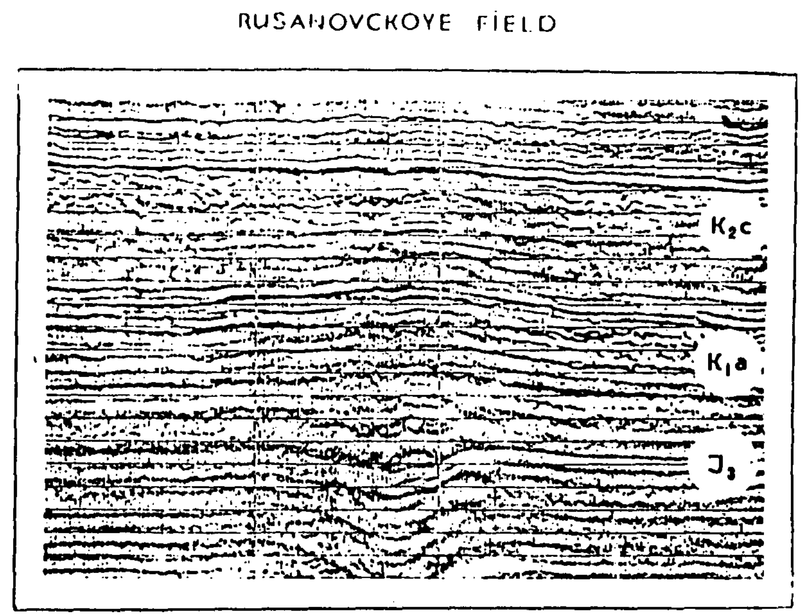

RUSANOVCKOYE FIELD
K_2c
K_1a
J_3

Fig.13